ARE BIG SCHOOLS BAD SCHOOLS?

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Abstract

As state governments shrink their budgets, more school districts are debating consolidation. In considering school consolidation, governments must evaluate costs per pupil and student achievement. Factors associated with costs per pupil include schools per district, district enrollment, income per individual, percent of pupils eligible for free lunch, pupil-teacher ratio, and average teacher salary. Factors associated with achievement include school enrollment, percent of pupils eligible for free lunch, suspension/expulsion rates, pupil-teacher ratio, and average teacher salary. This paper presents a regression model that analyzes the effects of school enrollment and schools per district on costs per pupil and standardized test passing rates in Indiana elementary and secondary schools. This model employed data from the Indiana Department of Education and the U.S. Internal Revenue Service. The results showed that districts with more schools had higher costs per pupil and that a school's enrollment had no significant effect on student achievement. In addition, the results suggest that school consolidation could cut costs while not necessarily lowering student achievement levels.

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ARE BIG SCHOOLS BAD SCHOOLS?:

Measuring the Effects of the Number and Size of Schools on District Costs and Student Achievement

Jamie Steiner, Quantitative Agricultural Economics

Figure 1. Jefferson High School in Lafayette, Indiana represents the state's tenth largest high school and maintained over 70 percent graduation rate in the 2007-2008 academic year. (Photo courtesy of Erica A. Morin.)

In 2007, former Indiana Governor Joseph Kernan and Indiana Supreme Court Chief Justice Randall Shepard were tasked with recommending ways to streamline local government. In their report, the Kernan-Shepard Commission recommended to "Reorganize school districts to achieve a minimum student population of 2,000" (Indiana Commission on Local Government Reform, 2007, p. 14). This recommendation has fueled heated conversations over school consolidation among elected officials, economists, taxpayers, and parents.

School consolidation combines two or more schools or school districts for economic or educational purposes. It is widely acknowledged that consolidating smaller school districts can lead to cost savings. Since each school must employ administrative, clerical, and maintenance staffs, district costs would be expected to decrease with a reduction in the number of schools a district operates.

Figure 2. (above) As Indiana's tenth largest school district, Ben Davis High School is able to provide outstanding library and research facilities for their students. (Photo courtesy of The Hagerman Group construction firm.)

Despite the clear economic advantages of consolidation, many communities are reluctant to reduce the number of schools in their area. Citizens often oppose consolidation out of fear that historical schools would be closed or due to a common belief that students perform better in smaller schools. Advocates for smaller schools cite reasons including smaller pupil-teacher ratios, higher participation in extracurricular activities, and increased parental participation. However, cost savings offered by larger schools may not be the only benefit of consolidation. Resources and specialized course offerings, such as foreign language options, Advanced Placement courses, and updated labs, are more readily available in large schools.

Differences in the strengths and weaknesses of small and large schools raise interest in determining whether the more intimate learning environments in small schools or the added resources of large schools have a greater impact on student success. While it is thought that fewer and larger schools reduce district costs, if research found that students enrolled in smaller schools experience enhanced achievement, school officials would be forced to choose between cost savings and enhanced achievement. If, on the other hand, research found that enrollment in large schools does not impede achievement, there could be a clear solution to the ever-present issue of school consolidation.

Costs per pupil decrease as district enrollment rises

Economic models measure how inputs, socioeconomic factors, and characteristics of districts and schools affect costs per pupil. These models frequently include

enrollment squared to determine if costs per pupil increase after enrollment reaches a certain level. The resulting conclusions most often reflect larger districts benefiting from lower costs per pupil. In fact, Bowles and Bosworth (2002) found that a 10% increase in school size decreases costs per pupil by approximately 2%.

Optimal enrollments and district configurations can help to minimize costs per pupil. According to Andrews, Duncombe, and Yinger (2002), the largest cost savings occur by increasing district enrollments from 500 students or less to 2,000 to 4,000 students. Costs per pupil then begin to increase after enrollments rise above 15,000 students. Districts with more middle schools and high schools have been found to be more costly per pupil (Zimmer, DeBoer, & Hirth, 2009; Bickel, Howley, Williams, & Glascock, 2001; Duncombe, Miner, & Ruggiero, 1995). In 2007, the majority of Indiana school districts were in the optimum range, or maintained smaller enrollment levels (see Figure 3).

Although models can assist with decision-making, implications of those models do not always make sense in reality. Duncombe et al. (1995) found that in New York State large cost savings per pupil could theoretically result from consolidating districts with enrollments smaller than 500 students. Upon further examination though, most New York districts with fewer than 500 students were not good candidates for full consolidation due to being located in sparsely populated rural areas. Reducing transportation, instructional, and operational costs per pupil through full consolidation would therefore be highly improbable for those districts. The study suggested that districts could instead achieve cost savings through partial consolidation by sharing administrative and support staffs.

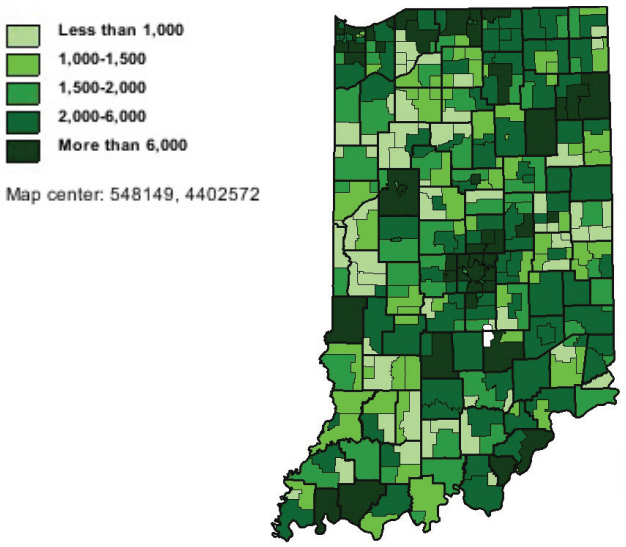

Figure 3. Indiana counties by school district enrollment, 2007. (Photo courtesy of Local Decision Makers.)

Achievement levels decline as schools grow

Researchers almost unanimously agree that increases in school building enrollments decrease achievement. In fact, all but one of the studies reviewed found that small schools foster increased student achievement. Lee and Smith (1997) found that the highest levels of student achievement occurred in medium-sized schools, ranging from 600 to 900 students. Schools with fewer than 300 students were found to have lower achievement, all else equal.

Models measuring achievement can be structured in many different ways. Achievement can be represented by variables such as standardized test scores, attendance rates, graduation rates, and the likelihood of participation in extracurricular activities. More indirect measures that often serve as distractions from a positive learning environment, including student safety, truancy, and pregnancy, can also gauge achievement levels. Pupil-teacher ratios, school enrollments, and teacher salary are a few variables that have been used to explain disparity in levels of student achievement.

Analyzing district cost data from Indiana

Data were collected for the 2007-2008 academic year from the Indiana Department of Education Web site, which maintains data on school revenues and expenditures, achievement measures, demographic values, and socioeconomic factors (Indiana Department of Education, 2010). Schools and districts were eliminated from the dataset if they were classified as adult educational facilities, career centers, correctional facilities, early-learning facilities, faith-based schools, mental health facilities, preparatory schools, private schools, special education, or vocational centers. After all exclusions were made, 292 districts with 2,483 schools remained. Since complete data for some schools were not available, the number of schools included in the regression models totaled 1,436.

Least squares regression models were used to estimate the effects of certain variables upon cost and achievement. In short, regression models can generally explain large amounts of data in a single equation. Separate models were created to measure cost and achievement. Data used for the cost regression models were collected at the district level to determine the effect of schools per district on district costs. Variables included in the model to explain costs per pupil were schools per district, district enrollment, district enrollment squared, adjusted gross income per individual, percent of pupils eligible for free lunch, percent of district enrollment in grades 7 and 8, percent of district enrollment in grades 10 through 12, pupil-teacher ratio, and average teacher salary. The cost model was run three times: once for districts of all sizes,

once for districts with more than 4,000 students, and once for districts with fewer than 4,000 students.

First and foremost, we were interested in determining the effect of schools per district on costs per pupil. Intuitively, one would expect districts with more schools to be more costly per pupil than districts with fewer schools, all else being equal. Therefore, we hypothesized that fewer schools per district would have a positive effect on costs per pupil. Confirmation of this hypothesis could lead to recommendations to consolidate schools within a district. Enrollment and enrollment squared were included to determine if districts in Indiana exhibit the typical U-shaped average cost curve found by many prior studies. This U-shaped curve would indicate declining costs per pupil for districts with small enrollments and rising costs per pupil for districts with large enrollments.

Another district characteristic that could define costs per pupil is the percentage of students enrolled in middle schools and high schools. Zimmer et al. (2009), Bickel et al. (2001), and Duncombe et al. (1995) found secondary schools, particularly high schools, to be more costly per pupil. It would be logical to expect that educating students in middle and high schools would be more costly than educating students in elementary schools due to an expanded subject matter in secondary education.

Two additional independent variables that reflect attributes of districts include adjusted gross income (AGI) per individual and the percentage of students eligible for the free lunch program. These variables reflect the socioeconomic status of school districts. Higher AGI per individual was expected to increase costs per pupil. Data were collected from the Internal Revenue Service (2008). Higher income communities are likely to have more years of education than average communities, and they would likely be willing to pay more for a higher quality of education. Large percentages of students eligible for free lunch indicate districts with high poverty levels. More resources would be needed to keep schools safe and productive, which would lead to higher costs per pupil.

Lastly, input costs were reflected in the cost models by average teacher salaries and pupil-teacher ratios. Rising average teacher salaries would likely lead to rising costs per pupil, while districts with more students per teacher would have lower costs per pupil.

District enrollment and cost analysis results

When all districts were included in the cost models, schools per district did not significantly change costs per pupil. However, when the sample was split into small (enrollments less than 4,000 students) and large (enrollments greater than 4,000 students) districts, schools

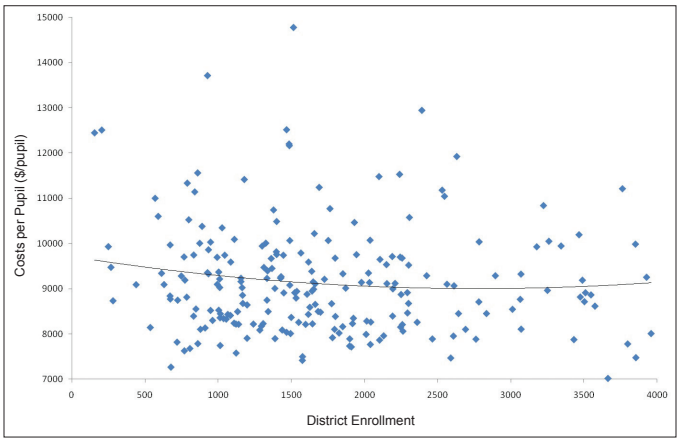

Figure 4. According to results, costs per pupil for Indiana school districts declined as enrollments increased until reaching the optimum enrollment of 2,912 students per district. Costs per pupil then progressively increased, similar to other reaserchers' findings.

per district had significant positive effects on costs per pupil for both samples. It is important to note the slight significance of small districts ($p<0.10$) and the sizeable significance of large districts ($p<0.01$) since most districts have fewer than 4,000 students. Looking at statistical significance does not fully portray these results. Economically, one additional school per district increased costs per pupil by approximately $65 for small and large districts, all else equal. For the average district in our sample, with an enrollment of 3,540 students, an additional school added about $230,000 to costs, an increase of approximately 1%.

Larger district enrollments significantly decreased costs per pupil in this study. Costs per pupil reached a minimum at an enrollment of 2,912 (see Figure 4). This finding fell within the 2,000-4,000 range cited by Andrews et al. (2002) and is near the minimum enrollment of 2,000 recommended by the Kernan-Shepard Commission in 2007.

As pupil-teacher ratios became larger in all districts and small districts, costs per pupil significantly fell as hypothesized ($p<0.001$). Pupil-teacher ratios were not significant for larger districts.

Higher average teacher salaries significantly increased costs per pupil. Costs per pupil in large districts were influenced less by higher average teacher salaries ($p<0.10$) than they were for all districts and small districts ($p<0.001$).

For districts of all sizes, the percent of seventh and eighth graders significantly changed costs per pupil at the 95% level. The models including all districts and only small districts experienced lower costs if they educated more seventh and eighth graders. Conversely, large districts had increased costs per pupil.

Socioeconomic factors significantly affected costs per pupil for all districts, regardless of enrollment levels. Districts with higher percentages of pupils eligible for free lunch had significantly higher costs per pupil for all districts ($p<0.001$). As incomes rose in small districts and all districts, costs per pupil significantly increased. Perhaps households in small districts have a higher willingness and ability to pay, or large district households may not feel as connected to their schools as do households in small districts.

Analyzing student achievement data from Indiana

Least squares regression models were also used to estimate the effects of variables on achievement. School-level data were used in these regressions to determine the effect of school enrollments on student achievement. Separate regressions were conducted for the three levels of schooling: elementary school (grades 1-5), middle school (grades 7-8), and high school (grades 10-12). Grade 6 was excluded due to varying grade configurations of elementary and middle schools in Indiana.

Achievement can be measured by many variables including standardized test scores, graduation rates, and college attendance rates. All students in grades 3 through 10 are required to take a standardized test, named the Indiana Statewide Testing for Educational Progress (ISTEP). School level ISTEP performance data were used in this study as a percent of students in a particular grade that pass both the mathematics and English portions of the ISTEP.

Explanatory variables included in the achievement models were school enrollment, percent of students eligible for free lunch, pupil-teacher ratio, average teacher salary, suspension/expulsion incidence rate, and percent of students with limited English proficiency. The variable of greatest interest in the achievement models for this study was school enrollment. Almost all research suggests lower rates of achievement in conjunction with higher enrollments. Therefore, it was hypothesized that larger school enrollments would depress ISTEP passing rates.

Class sizes and teacher quality have the potential to influence standardized test passing rates. Smaller class sizes, measured by pupil-teacher ratios, would intuitively boost performance rates with a presumed increase in teacher-student interactions. Therefore, we expected achievement rates to be lower with larger pupil-teacher ratios. Average teacher salary was used in this study as a proxy for teacher quality or experience. It was expected that teachers of higher caliber, possibly with more teaching experience, would be paid higher salaries and would better educate their students. Higher salaries were then hypothesized to have a positive effect when estimating standardized test passing rates.

Disruptions and disciplinary problems were expected to depress performance levels not only for students being suspended or expelled, but also for students in the same classes as suspended or expelled students. It is for this reason that suspension/expulsion rates were hypothesized to have a negative effect on student achievement.

Socioeconomic factors often highly influence student achievement levels. To capture socioeconomic status, the percent of students eligible for free lunch and the percent of students with limited English proficiency were used as explanatory variables. Higher levels for both of these variables were expected to lower ISTEP passing rates.

Student achievement results

Contrary to the results of much existing literature, this study found that having large school enrollments had little effect on ISTEP passing rates. School building size, as measured by enrollment, actually had a positive effect for elementary, middle, and high schools. This result was only significant, albeit slightly, for middle schools.

In addition to the finding on school enrollments, two themes emerged from this set of models focusing on achievement. First and foremost, larger proportions of students eligible for free lunch within a school depressed ISTEP passing rates at very high levels of significance ($p<0.001$) for elementary, middle, and high schools. Unfortunately, this result shows that it is difficult to overcome the power that socioeconomic factors, such as poverty, have on achievement.

Secondly, passing rates for elementary, middle, and high schools were significantly higher when teachers were paid larger salaries. This result was much more significant for

Figure 5. Smaller pupil-teacher ratios often enhance student learning and achievement levels.

high schools and elementary schools ($p<0.001$) than it was for middle schools. If higher teacher salaries signal better teachers, then better teachers improve learning. On a related note, smaller pupil-teacher ratios boosted achievement. This result was only significant for high schools.

As expected, higher suspension/expulsion rates significantly decreased passing rates, with younger students more affected than high school students. This would tend to make sense due to disruptive behaviors perhaps being more of an interruption to the learning process for younger students.

Larger proportions of students with limited English proficiency significantly increased ISTEP passing rates for high schools and elementary schools. This result is exactly opposite of what we expected, as it would be plausible to expect standardized test scores to be lower if students have difficulty reading or understanding the exams. One possible explanation could be that a student's English skills were only limited to the extent that he or she could still pass the English portion of the exam.

Conclusion

Consolidation will remain a hot-button topic as long as state governments continue to fund public education. With budgetary shortfalls occurring in many states across the country, the arguments surrounding school consolidation will remain controversial. While governments attempt to make education more cost efficient, citizens continue to demand higher quality education for their children and maintain connections to their traditional schools. If a primary goal of state governments is to educate children at the minimum level of expenditures per pupil, the findings clearly point to consolidation at both district and school building levels. However, if the goal is to produce high-achieving students while holding expenditures per pupil low, factors other than cost research should be assessed.

The objective of this study was twofold: to determine how the number of schools per district affects costs per pupil and to determine whether larger schools do in fact depress student achievement levels. It was found that having fewer schools per district does decrease costs per pupil, until reaching an enrollment of 2,912 students. Contrary to common beliefs and the arguments of opponents to consolidation, this study found that larger schools do not depress student achievement, as measured by ISTEP passing rates. Perhaps larger schools, which can offer more resources and specialized course offerings, positively affect student achievement. By combining these two findings, the results of this study would suggest consolidation of smaller school districts and consolidation within districts to decrease the number of schools per district.

Further research should continue to examine the potential effects of consolidation on costs of education and student achievement. In addition, case-by-case examination of districts must occur before adopting consolidation options. Until a consensus is reached and confirmed, state governments and school boards must carefully consult with community members, consider school and district characteristics—especially levels of income and poverty—before consolidating schools or districts.

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